

Interactive comment on “Environmental Conditions for Alternative Tree Cover States in High Latitudes” by Beniamino Abis and Victor Brovkin

Anonymous Referee #1

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GENERAL COMMENTS

The manuscript by Abis and Brovkin aims to determine the impact of several environmental variables (EVs) on the tree cover fraction in the boreal areas, and to assess the existence of different vegetation states under the same environmental conditions. Through the combined use of different statistics, they found that regions with same environmental conditions and different tree cover states cover about 5% of the boreal area, whereas in the rest of the regions the EVs determine a single vegetation states. Multimodality in tree cover is largely being studied in the tropical regions, and less works exist about multimodality in boreal forest.

- Overall, this study is interesting and novel. However, I think that, especially in the

Introduction Section, it is not sufficiently framed in the context of cited references regarding the boreal forest biome. In this regard, I suggest to expand the description of the current knowledge about the boreal forest biome.

- Overall, the scientific approach and the applied methods are valid and good, however I think that the links between the different statistics involved should be better described. For example, it should be better clarify in the text how the information learned by applying one statistic are useful for making decision in applying the others.
- Finally, I suggest to revise the structure and the text of the paper in order to avoid repetitions and make the manuscript more readable. In this regard, in particular I suggest to merge the Discussion and Conclusion sections.

In these regards and apart from these, in the following I report more specific comments:

SPECIFIC COMMENTS

- 1 Introduction

Pag 2, Lines 6-10: "To such avail ..[] (Reyer et al. 2015)" I suggest introducing the boreal forest biome before this sentence or immediately after.

In general, I suggest to reduce the description of the bimodality in tropical vegetation and to expand the description of the boreal forest, because at the moment in the manuscript they have almost the same importance. Since the study is about the boreal forest I think that the Introduction should be focused mainly on the state of the art of the study about of this biome, in order also to highlight the novelty of this study.

In particular: Pag. 2, Lines 29-33: Since most of these environmental variables are those considered in this work, could you give more information about their role in the boreal forest biome, and also more information about the cited studies? E.g. if these papers considered only some specific areas, the main knowledge about the variable interactions... Pag. 2 Lines 33-34: In order to explain better the role of boreal forest in the climate system, could you provide a more extended description of some feedbacks

between each other?

BGD

Pag. 3 lines 3-7: I suggest to describe more extensively the main outcomes of Scheffer et al. 2012, in particular detailing what they found about the existence of multiple states under the same environmental variables in boreal forest, in order to better introduce the current knowledge about multimodality, what is missing and thus the timely of the study reported in this manuscript.

- 2 Methods and Materials

- 2.1 Environmanetal Variables Datasets

Pag. 3 Lines 20-21: More information about current knowledge on the importance of these variable in the boreal forest biome, which I suggested to include in the Introduction, could alternatively be reported here.

Pag. 3 Line 21: “[. . .] they are summarised in Table 1”. I suggest to modify the sentence for inserting also the kind of information provided by Table 1.

Pag. 3 Line 22: Please insert at the beginning of the sentences the name of the tree cover dataset (i.e. MODIS).

Although Table 1 has the references of all the datasets, I suggest to provide, in the text or in an additional column of Table 1, a brief description of all the variables, or at least of the variables that need a definition (e.g. what the permafrost index indicates, the type of soil texture, the definition of GDD0, the depth at which the soil moisture refer to...).

- 2.2 Data Analysis

Could you report in the text the information about the GAM implementation? Such as the assumed error distribution of the data and the implemented link function.

Pag. 5, Line 22: why do you use only 6 variables for the multiple-dimensional phase-space instead of 8? This is currently explained later on, but to improve clarity I suggest

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to explain the reason here, or to refer directly to Sec. 3.2 for the explanation.

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- 3 Results

- 3.3 6D phase-space classification results

How many are the total found classes?

Pag. 10 Lines 1-2: "Qualitative [...] high." Is it possible to provide the quantitative values of the extremes of the qualitative index for each variable? For example, what are the extreme values of the qualitative range called "medium-low" for FF? Furthermore, how do these ranges change for the different regions?

Pag. 13. Line 4: "Depending on the conditions, only one of the three possible vegetation states is attained." It is possible to provide some examples?

- Table 1

I suggest including in the table also the measure units of the variables.

- Table 4

I suggest adding a column with the number of gridcells found in each class.

TECHNICAL CORRECTIONS

- 2.2 Data Analysis

Pag. 5, Line 19: "or" instead of "ot", please fix the typo.

Pag. 6, Line 10: Please rephrase the sentence "(generally at least 1% of the gridcells with the same vegetation state)"

- Table 1

Please replace "0.05° MODIS MOD44B V1 C5 2010 product" with "0.05° MODIS MOD44B V1 C5 2001-2010 product"

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